TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PROVIDE METHODOLOGY TO RELATE INFORMATION DERIVED FROM SITEWIDE-SCALE GROUNDWATER FLOW MODELING TO THE VARIOUS SCALES ASSOCIATED WITH ASSESSING IMPACTS IN THE RIVER ENVIRONMENT

Identification No.: RL-SS37
Date: September 2001

Program: Environmental Restoration
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit(s): Broad need potentially applicable to multiple operable units.
PBS No.: RL-SS04 (RL-VZ01)
Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])
TSD Title: N/A
Waste Management Unit (if applicable): N/A
Facility: N/A

***Priority Rating*:**

This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

X 1. Critical to the success of the ACPC
____ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
____ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

***Need Title*:** Provide Methodology to Relate Information Derived from Sitewide-Scale Groundwater Flow Modeling to the Various Scales Associated with Assessing Impacts in the River Environment

Need/Opportunity Category: Technology Need

***Need Description*:** This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an "integrated" need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this "integrated" need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where

a specific technology need can be defined separately from an "integrated" need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

The technical gap associated with this need involves the means by which contaminant transport information derived from groundwater flow models (see RL-SS35) can be used when conducting impact assessments for various elements of the river system. The problem involves relating the spatial and temporal scales associated with a Pasco Basin groundwater transport model, to the scales associated with assessing impacts to sensitive habitat and individual receptors. New methods are needed to establish credible estimates for contaminant characteristics at exposure sites in the river, when using the output from groundwater transport models. Organisms potentially exposed to groundwater-derived contaminants may occupy one or more microhabitats that will significantly affect their exposure to groundwater. Thus, benthic invertebrates such as larval insects may be exposed to pure groundwater in some cases, and nearly pure river water in others (e.g., Hope and Peterson 1996). Because river water over much of the Reach does not contain contaminants in concentrations sufficient to put organisms or humans at risk (in contrast to groundwater), the differences in assessment of impact can be dramatic (DOE 1996).

Specific aspects of research to address this technical gap include the following:

- Developing the modeling capabilities to quantify the changes in groundwater characteristics that take place in the zone of interaction between the aquifer and the river.

- Developing the modeling capabilities to characterize the flow path of water within the zone of interaction, which is strongly influenced by river stage fluctuations.

Developing the algorithms for estimating contaminant concentrations in the river environment (using the output from groundwater flow models – see RL-SS38) that consider the potential physical and chemical changes that may occur in the zone of interaction. This model will provide the capability to convert a broad-scale groundwater flux into a spatially-distributed set of concentrations in three dimensions as the flux enters the river environment. This model will reflect the benthic substrate diversity, river flow, and river physio-chemical characteristics (see RL-SS36) necessary to provide concentration estimates that reflect bioavailability as well as habitat specificity.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with contaminant flux is needed in the FY04 timeframe to meet these objectives.

***Problem Description*:** This need falls under the River Technical Element within the S&T Endeavor. The River Technical Element is intended to support and provide information necessary for an assessment of the effects of Hanford-derived materials and contaminants on the Columbia River environment, river-dependent life, and users of river resources. The objectives of the river technical element are to provide relevant and meaningful information to support remedial decisions and subsequent risk and system assessments, to guide ongoing and subsequent environmental surveillance programs, and to focus future iterations of the cumulative river assessment. Meeting the objectives will enhance protection of human health and the environment by providing scientifically defensible knowledge and data and identifying existing and new S&T that will serve as input to DOE's decision-making process for Hanford cleanup.

The scope of this technology need encompasses the groundwater-river interface as it relates to the fate and transport of groundwater contamination entering the river environment. These include factors that modify the physical/chemical form and concentration of groundwater-borne contaminants within the zone of influence of the Columbia River up to the point that they enter the river proper.

Key topics in this need include mixing (dilution) with river water, effects of geochemical conditions of the sediment and river water on contaminant physical and chemical state, the influence of preferential pathways (e.g., cobble vs. silt-clay sediments), and the effects of spatial heterogeneity in hyporheic sediment composition on contaminant concentrations entering the river. Credible conceptual and numerical models for processes occurring in this zone are needed to quantify accurately (1) impacts to the river's ecosystem; and (2) risks to human receptors.

Benefit to the Project Baseline of Filling Need: Filling this need will reduce the uncertainty in impact and risk assessments associated with river-related receptors. The uncertainties introduced in converting groundwater flux information into biological exposures are large, and may cover several orders of magnitude (DOE 1996). In the absence of this technology, a variety of conservative estimations have been used at Hanford that may greatly inflate (DOE 1998) or underestimate (DOE 1993) risks. The uncertainty in decisions about cleanup and impact may therefore be large. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

***Functional Performance Requirements*:** The techniques applied or information that is obtained must provide an accurate understanding of current conditions over time and the ability to assess potential future conditions, near- and long-term. In addition, the evaluation must allow for the differentiation between contaminant contributions from Hanford and other sources (natural and/or anthropogenic). The information obtained must be applicable toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4 ***TIP No.:***

Relevant PBS Milestone: PBS-MC-042

***Justification For Need*:**

Technical: There are insufficient means to translate groundwater contaminant flux estimates into information at the scale of biological exposures that are necessary to estimate impacts from groundwater contaminants entering the river.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in $000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is $200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in "Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment" (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

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References:

Hope, S.J., and R.E. Peterson. 1996. Chromium in River Substrate Water and Adjacent Groundwater: 100-D/DR Area, Hanford Site, Washington. BHI-00778, Bechtel Hanford, Inc., Richland, Washington.

United States Department of Energy. 1993. Columbia River Impact Evaluation Plan. DOE/RL-92-28, U.S. Department of Energy, Richland, Washington.

United States Department of Energy. 1998. Columbia River Comprehensive Impact Assessment, Part II; Requirements for a Columbia River Comprehensive Impact Assessment. DOE/RL-96-16. United States Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.